UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105

September 30, 2004

Bruce Wolfe
Executive Officer
California Regional Water Quality Control Board,
San Francisco Bay Region
1515 Clay Street, Suite 1400
Oakland, CA 94612

Re: **Five-Year Review Report for the Advanced Micro Devices Site-901/902 Thompson Place, Sunnyvale, CA**

Dear Mr. Wolfe

The U.S. Environmental Protection Agency, Region 9 (EPA) has reviewed the second Five-Year Review Report for the Advanced Micro Devices-901/902 Thompson Place (AMD 901/902) Superfund Site, prepared by the California Regional Water Quality Control Board, San Francisco Bay Region, dated September 30, 2004. This Five-Year Review was conducted as a matter of EPA policy because cleanup of the site will take five years or more to complete (see OSWER No. 9355.7-03B-P, *Comprehensive Five-Year Review Guidance*, June 2001). The review addresses remedial actions taken pursuant to the September, 1991 Record of Decision for the site.

EPA concurs that the remedy for the AMD 901/902 site currently protects human health and the environment because institutional controls are in place that prohibit the use of shallow groundwater. In order for the remedy to be protective in the long term, the groundwater extraction and treatment remedy will need to be re-evaluated with regard to its ability to meet remedial action objectives. EPA and the RWQCB are deferring making a protectiveness statement regarding vapor intrusion because an analysis of human health risks from this pathway has not been completed.

The next Five-Year Review for the AMD 901/902 site is due on September 30, 2009. For the next Five-Year Review, EPA recommends that a joint Five-Year Review Report be prepared for the TRW Microwave, AMD 901/902, and AMD 915 facilities. These facilities are located adjacent to one another and share many common characteristics. A single ROD was written for the TRW, AMD 901/902, and Philips facilities (Philips is no longer an NPL site and is being cleaned up under RCRA authority). Groundwater plumes from these three facilities have commingled to form the Companies' Offsite Operable Unit. The groundwater treatment system at AMD 915 is operated by Philips and treats groundwater from both the AMD 915 site and the Offsite OU. The preparation of a single Five-Year Review report for the three facilities would

reduce redundancy and would allow readers to more fully understand the cleanup issues in the area.

EPA appreciates the opportunity to work with you on this report. If you have any questions, please feel free to contact Debbie Schechter of my staff at 415-972-3230.

Sincerely,

Elizabeth Adams, Chief
Site Cleanup Branch
Superfund Division

California Regional Water Quality Control Board
San Francisco Bay Region

Terry Tamminen
Secretary for Environmental Protection

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Arnold Schwarzenegger
Governor

Date: September 30, 2004
File No. 43S0125 (KER)
43S0080 (KER)
43S0973 (KER)

Ms. Elizabeth Adams
Chief, Site Cleanup Branch
Superfund Division
U.S. EPA Region 9
75 Hawthorne Street
San Francisco, CA 94105

SUBJECT: Submittal of Five-Year CERCLA Review for Eastern Sunnyvale TRW and AMD Superfund Sites, Sunnyvale, Santa Clara County, California.

Dear Ms. Adams:

Enclosed for your records and review is a copy of the Five-Year Review for the following Superfund sites:

- Former TRW Microwave site at 825 Stewart Drive
- AMD 901/902 Thompson Place site
- AMD 915 DeGuigne Drive site
- AMD 1165 East Arques Avenue site (formerly Monolithic Memories)

If you have any questions please contact Keith Roberson of my staff at 510 622 2404 or email ker@rb2.swrcb.ca.gov .

Sincerely,

Bruce H. Wolfe
Executive Office

California Regional Water Quality Control Board
San Francisco Bay Region

Five-Year Review

Advanced Micro Devices Site
901/902 Thompson Place
Sunnyvale, Santa Clara County, California

Report Approved by: _____

Stephen A. Hill
Chief, Toxics Cleanup Division
California Regional Water Quality Control Board
San Francisco Bay Region

Table of Contents

List of Acronyms

AMD	Advanced Micro Devices, Inc.
ARAR	Applicable or Relevant and Appropriate Requirements
bgs	Below Ground Surface
BPHE	Baseline Public Health Evaluation
DCE	dichloroethene
ESL	Environmental Screening Levels
FRAP	Final Remedial Action Plan
GETS	Groundwater extraction and treatment system
ISB	In situ bioremediation
MSCA	Multi-State Cooperative Agreement
MCL	Maximum Contaminant Level
ug/L	micrograms per liter
ug/m^3	micrograms per cubic meter
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
PCE	tetrachloroethene
RCRA	Resource Conservation and Recovery Act
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
RWQCB	Regional Water Quality Control Board
SCR	Site Cleanup Requirements
SVET	Soil Vapor Extraction and Treatment
TCA	1,1,1-trichloroethane
TCE	trichloroethene
TRW	TRW Corporation
USEPA	United States Environmental Protection Agency
VC	Vinyl chloride
VOC	Volatile Organic Compound

Executive Summary

The remedy for groundwater contamination at the Advanced Micro Devices (AMD) Superfund site at 901/902 Thompson Place in Sunnyvale, California, has included soil excavation, groundwater extraction and treatment (GWET), groundwater monitoring, and institutional controls. This is the second five-year review for the AMD 901/902 site, and it covers remedial activities conducted between September 1996 and April 2004. The first review covered activities between September 1991 and August 1996.

Remedial actions conducted at the site are achieving success. Groundwater extraction began in 1984 and continues to the present. Groundwater concentrations have declined across the pollution plume but are approaching asymptotic levels. AMD has completed a pilot test of in situ bioremediation (ISB), and has recommended implementing ISB as a full-scale remedy for contamination at the 901 Thompson Place facility. Until cleanup goals are achieved, the remedy is protective of human health and the environment in terms of limiting ingestion of contaminated water through the use of institutional controls prohibiting the use of shallow groundwater.

The existing soil and groundwater remedy does not address risks from long-term exposure through the vapor intrusion pathway. Since the issuance of the ROD, new information has been developed concerning the toxicity of TCE and potential vapor intrusion into buildings overlying shallow groundwater contamination. This information, and other recent changes in the methodology of assessing risk from VOCs, requires a re-evaluation of the protectiveness of the remedy in terms of its ability to limit exposure to VOC vapors in indoor air. Indoor air has not been sampled at the AMD 901/902 Thompson Place site. While the available data suggest human health risks should be minimal, RWQCB and USEPA are deferring making a protectiveness statement until an analysis of the risks at this site from the vapor intrusion pathway has been completed.

Five-Year Review Summary Form		
SITE IDENTIFICATION		
Site Name (from WasteLAN): **Advanced Micro Devices, Inc.**		
EPA ID (from WasteLAN): **CAD048634059**		
Region: 9	**State: CA**	**City/County: Sunnyvale/Santa Clara**
SITE STATUS		
NPL status: Final		
Remediation Status: Operating		
Multiple OUs? No	**Construction completion date: 1984**	
Has site been put into reuse? The site has been vacant since January 2001.		
REVIEW STATUS		
Lead agency: State of California		
Author Name: Keith Roberson		
Author title: Engineering Geologist	**Author affiliation: CA Regional Water Quality Control Board (Lead Agency)**	
Review period: June 1996 to June 2004		
Date(s) of site inspection: 2/11/04		
Type of Review: (in bold) **_**Post-Sara _Pre-Sara _NPL-Removal only _Non-NPL Remedial Action Site x **NPL State/Tribe-lead** _Regional Discretion		
Review number: (in bold) _1 (first) x **2 (second)** _3 (third) Other (specify)		
Triggering action: (in bold) _Actual RA Onsite Construction at OU#__ _Actual RA Start at OU#__ _Construction Completion x **Previous Five-Year Review Report** _Other (specify)		
Triggering action date (from WasteLAN)**:** 9/30/1996		
Due Date: 9/30/2004		

Five-Year Review Summary Form, continued

Issues:
Three issues identified during the review are 1) mass removal efficiency of the groundwater extraction and treatment (GWET) remedy is declining over time, and may not be capable of achieving groundwater cleanup goals on a reasonable schedule; in situ bioremediation (ISB) may have greater potential towards achieving site cleanup goals than continuing GWET; 2) possible offsite migration of VOCs from this site may inhibit long-term remedial success at downgradient sites; 3) the vapor intrusion threat has not been assessed at this site.

Recommendations and Follow-up Actions:
The discharger is proposing to implement a full-scale ISB remedy at the site, based on success of a recently completed pilot test. Any remedy implemented at the site must ensure that contaminated groundwater does not migrate to downgradient properties. The ROD will need to be amended if the remedy is permanently changed from GWET to ISB. To assess the potential for vapor intrusion, indoor air needs to be sampled and the potential human health risk associated with vapor intrusion into indoor air evaluated.

Protectiveness Statement:
Remedial actions conducted at the site are achieving success, and it appears possible that groundwater cleanup goals can be achieved within five to ten years. The remedy is currently protective of human health and the environment in terms of limiting ingestion of contaminated water through the use of institutional controls prohibiting the use of shallow groundwater.

The existing soil and groundwater remedy does not address risks from long-term exposure through the vapor intrusion pathway. Since the issuance of the ROD, new information has been developed concerning the toxicity of TCE and potential vapor intrusion into buildings overlying shallow groundwater contamination. This information, and other recent changes in the methodology of assessing risk from VOCs, requires a re-evaluation of the protectiveness of the remedy in terms of its ability to limit exposure to VOC vapors in indoor air. Indoor air has not been sampled at the AMD 901/902 Thompson Place site. While the available data suggest human health risks should be minimal, RWQCB and USEPA are deferring making a protectiveness statement until an analysis of the risks at this site from the vapor intrusion pathway has been completed.

California Regional Water Quality Control Board
San Francisco Bay Region

Five-Year Review

Advanced Micro Devices, Inc.
901/902 Thompson Place
Sunnyvale, California

I. Introduction

This report is the second five-year review for the Advanced Micro Devices, Inc. (AMD) Site at 901/902 Thompson Place in Sunnyvale. The California Regional Water Quality Control Board, San Francisco Bay Region (RWQCB), conducted this review pursuant to the Multi-Site Cooperative Agreement (MSCA) between the U.S. EPA Region 9 (USEPA) and the RWQCB. Pursuant to its 1991 Site Cleanup Requirements (RWQCB Order No. 91-102), AMD evaluated the remedial activities performed at the site to determine if the selected cleanup plans are working. The results were presented to the RWQCB in a Five-Year Review Report submitted on June 19, 2001. The purpose of a five-year review is to ensure that a remedial action remains protective of public health and the environment and is functioning as designed. The five-year review is required because hazardous substances, pollutants, or contaminants remain at the site above levels that allow for unlimited use and unrestricted exposure.

II. Site Chronology

AMD begins semiconductor assembly at 901 Thompson Place	1969
AMD begins semiconductor assembly at 902 Thompson Place	1972
Soil and groundwater contamination discovered at the site	1982
Removal of acid neutralization systems and associated contaminated soils from both buildings	1983 - 1984
Groundwater extraction and treatment begins. NPDES permit issued for discharge of treated effluent.	1983
RWQCB issues Waste Discharge Requirements Order	Sept 1985
Site formally added to the National Priorities List (NPL)	June1986
RWQCB adopts Site Cleanup Requirements order	Dec 1987
Baseline Public Health Evaluation completed for site	1990
RWQCB and USEPA approve Final RI/FS Report and Final Remedial Action Plan (FRAP) for AMD and adjacent TRW and Philips sites	June 1991
RWQCB adopts Order No. 91-102, the Final Site Cleanup Requirements for the site.	June 1991
USEPA issues Record of Decision (ROD)	Sept 1991
AMD stops industrial operations at the site	1992
AMD submits first Five-Year Review Report to RWQCB	Sept 1996
AMD submits second Five-Year Review Report to RWQCB	Sept 2001
In situ bioremediation pilot project initiated in former VOC source area at	Dec 2002

901 Thompson Place	
AMD proposed in situ bioremediation as final remedy for AMD 901 Thompson Place	Sept 2004

III. Background

Physical Characteristics

The AMD 901/902 Thompson Place site is located south of Highway 101 in Sunnyvale (see attached map). The site is located in a light industrial and commercial area dominated by the electronics industry that is known as the Silicon Valley, which is a portion of the larger Santa Clara Valley. Sunnyvale has a population of approximately 100,000, and is part of the San Francisco Bay Metropolitan Region, which has a total population of about six million. Most buildings in the vicinity are low-rise developments containing office space and research and development facilities.

Two large, low-rise industrial buildings occupy the site. Groundwater contamination from this site, consisting primarily of trichloroethylene (TCE) and related chlorinated volatile organic compounds (VOCs), commingles with similar discharges from three nearby sites: the former TRW Microwave site at 825 Stewart Drive, which is located to the north; the Philips Semiconductors site at 811 East Arques Avenue site, which is located to the west; and another AMD facility at 915 DeGuigne Drive, which is located north of TRW. Both of the AMD sites and the TRW Microwave site are Superfund sites, whereas the Philips site is regulated under the RCRA program. The commingled groundwater VOC plume that has migrated northward from the AMD, TRW, and Philips sites is referred to as "The Companies" Offsite Operable Unit.

Site Operational History

Industrial operations began at the site in 1969, when AMD began manufacturing printed circuit boards and semiconductors at 901 Thompson Place. AMD began operations at 902 Thompson Place in 1972. AMD operated the facility until 1992. Operations were continuous with no significant process changes between 1969 and 1992. During this time, TCE and other industrial solvents were used for cleaning and degreasing. Acids were used for etching and caustics were used for acid neutralization. Hazardous wastes were generated and stored as a by-product of operations. Acid neutralization systems (ANS), including in-ground sumps, were used at both AMD buildings between 1969 and 1984.

The buildings were vacated by AMD in 1992. AMD still owns the site and uses it for storage and emergency response training. No other entity has occupied the site.

This five-year review covers only remedial activities conducted at the AMD 901/902 Thompson Place site. Separate Five-Year Reviews will be prepared and issued for the adjacent Superfund sites at 825 Stewart Drive and 915 DeGuigne Drive.

Hydrogeology
The site is located in the Santa Clara Valley, a structural basin filled with marine and alluvial sediments. The coarser deposits are probably the result of deposition in or near stream channels that drain the highlands that surround the basin. Finer-grained deposits result from a variety of conditions with the eventual result of a heterogeneous sequence of interbedded sands, silts, and clays. The natural groundwater flow direction beneath the site is to the north towards San Francisco Bay. Municipal water supply wells tap an extensive, deep, regional, confined aquifer that lies generally greater than 200 to 300 feet below ground surface (bgs). A thick, relatively impermeable aquitard separates this deep aquifer from a complex series of laterally discontinuous aquifers and aquitards that can extend up to within a few feet of the ground surface.

Four distinct water-bearing zones in the upper 100 feet bgs have been characterized at this site. These coarse-grained, transmissive units are generally composed of sand or sandy gravel. The first encountered water-bearing zone, called the A-zone, is found from about 5 to 25 feet bgs. The next encountered water-bearing zone is called the B1-zone and is found from about 30 to 45 feet bgs. The B2-zone is typically found between 45 and 60 feet bgs. Contamination at this site extends down to about 65 feet. Deeper aquifers used as drinking water sources have not been impacted by chemicals at this site. The upper aquifer zones are separated by variable thicknesses of clay to silty sand. There is some degree of hydraulic connection between the zones due to the discontinuous nature of the sediment types. The highest concentrations of contaminants exist in the A-zone and B1-zone. VOCs are also present in elevated concentrations in the B2-zone beneath the site. The commingled groundwater VOC plumes from the Philips, AMD, and TRW sites in the A- and B1-zones are approximately 4,000 feet long and extend northward beyond Highway 101.

History of Contamination
Site remedial investigations began in 1982 with the discovery of leakage from an acid neutralization sump at 901 Thompson Place. The main contaminant of concern at the site is TCE. The sources of the contamination were determined to be leaking ANS sumps at each building. Additional remedial investigations determined the extent of contamination. VOCs in groundwater are limited to water-bearing units in the upper 65 feet that are not used for public water supply.

Initial Response
Remedial action at the site began in 1983 with the removal of the ANS systems and 217 cubic yards of associated contaminated soils. Operation of the groundwater extraction and treatment (GWET) system began in 1983.

Summary of Basis for Taking Action
The site overlies the Santa Clara Valley groundwater basin. Groundwater from this basin provides up to 50% of the municipal drinking water for over 1.4 million residents of the Santa Clara Valley. The AMD site was made a Superfund site primarily because of the past chemical releases' potential threat to this valuable resource.

IV. Remedial Actions

Remedy Selection

A Baseline Public Health Evaluation (BPHE) was submitted in 1990. The Remedial Investigation/Feasibility Study (RI/FS) was approved by USEPA and the RWQCB in June 1991. These documents form the basis of the remedial action plan. The RWQCB adopted Final Site Cleanup Requirements (SCR) Order No. 91-102 in June 1991. The Final SCR contain the approved remedy for cleanup at the site. A Record of Decision (ROD) was issued by USEPA in September 1991. The remedy selected in the SCR and the ROD consisted of the following elements:

1) groundwater extraction
2) treatment of extracted groundwater by air stripping or ozone oxidation
3) discharge of treated water under NPDES permit
4) deed restriction prohibiting the use of shallow groundwater for drinking water.

The SCR set groundwater cleanup standards at California proposed or adopted Maximum Contaminant Levels (MCLs), USEPA MCLs, California Action Levels, or levels based on a risk assessment. The groundwater cleanup levels are:

Chemical	Cleanup Standard (ug/L)
1,1-dichloroethane (1,1-DCA)	5
cis-1,2-dichloroethene (cis-1,2-DCE)	6
trans-1,2-dichloroethene (trans-1,2-DCE)	10
1,1-dichloroethene (1,1-DCE)	6
Freon 113	1,200
vinyl chloride	0.5
Tetrachloroethene (PCE)	5
1,2-dichlorobenzene (1,2-DCB)	600
1,1,1-trichloroethane (1,1,1-TCA)	200
trichloroethene (TCE)	5

Remedy Implementation

The GWET system and groundwater monitoring program were fully implemented at the time the final SCR was adopted in 1991. A deed restriction was prepared for the property and recorded with the Santa Clara County Records Office on January 17, 1994 (copy

attached). The deed restriction prohibits the use of groundwater from the shallow aquifer (i.e., A- and B-zone aquifers as described above) as a source of drinking water.

Groundwater Extraction
Groundwater remediation began at the site in 1983 with installation of two dewatering sumps and one groundwater extraction well. Additional extraction wells were added to the system in 1989 and in 1993. Currently, the GWET system includes 8 onsite groundwater extraction wells that are screened in the A-, B1-, and B2- aquifer zones. The system provides hydraulic capture of the VOC plume and has reduced groundwater VOC concentrations across the site. A total of 807 pounds of VOCs has been removed from 230 million gallons of groundwater extracted at the site during GWET (1983 to present). Treated groundwater is discharged to an on-site storm sewer under RWQCB Order No. 94-087 and NPDES Permit No. CAG912003, both issued in December 1994. The storm sewer discharges into Calabazas Creek at Highway 101.

Systems Operation/O&M
The GWET system has been conducted continuously at the site since 1983. AMD submits groundwater monitoring reports to the Water Board annually. Costs associated with operation and maintenance of the GWET, the ISB pilot test, and associated reporting, between 1996 and 2004 totaled $1,585,000.

V. Progress Since Last Review

Groundwater Extraction and Treatment
Between 1996 and 2004, 106 million gallons of groundwater were extracted, from which 196 pounds of VOCs were removed. Mass removal efficiency during this period was 1.85 pounds per million gallons (lbs/MG). Prior to 1996, 611 pounds of VOCs were removed from 192 million gallons of extracted water, yielding a mass removal efficiency of 3.1 lbs/MG. Thus, mass removal efficiency has declined by 38% since 1996. A total of 807 pounds of TCE has been removed through GWET at the site since 1983.

While mass removal efficiency is declining over time, VOC concentrations across the plume also continue to be reduced. Remedial efforts have reduced VOC concentrations in source areas and across the plume, however, VOC concentrations in groundwater remain above cleanup objectives due to the complexity of site hydrogeology and the technical limitations of the remedial methods. Maximum VOC concentrations in on-site groundwater have been reduced by two orders of magnitude, from over 1,000,000 ug/L when contamination was first measured in August 1983 to 26,600 ug/L (total VOCs) in October 2003. The current maximum VOC concentrations remain in the former source area at 901 Thompson Place, in the vicinity of extraction well DW-1. Concentrations in this well have risen significantly since October 2002 because extraction from this well was suspended to facilitate the *in situ* bioremediation (ISB) pilot test.

In Situ Bioremediation
In December 2002, an ISB pilot test was initiated at the former source area at 901 Thompson Place to test the possibility of accelerating groundwater remediation through

the use of methods other than groundwater extraction. A recirculation system, consisting of an injection well, and extraction well, and an intermediate monitoring well, was constructed in the former VOC source area for the pilot test. Some extraction wells in the immediate vicinity of the injection area were turned off, with approval from RWQCB, to facilitate the ISB program. Extraction wells along the downgradient property boundary remained operational to prevent offsite migration of VOCs during the pilot test. The test consisted of injecting a carbohydrate source as an electron donor to stimulate the activity of indigenous microbial organisms known to biodegrade chlorinated VOCs. Water was extracted at the downgradient end of the recirculation system, then reinjected in the injection well. The pilot test operated from December 2002 through May 2004.

The results of the pilot test indicate that chlorinated VOCs at the site can be effectively removed from groundwater through microbially-assisted reductive dechlorination. The process followed the predicted sequential destruction of TCE to cis-1,2-DCE, followed by conversion of DCE to vinyl chloride, and vinyl chloride to ethene. TCE was almost completely degraded in the treatment zone, with concentrations dropping from 300 micrograms per liter (ug/L) to less than 5 ug/L.

No potentially toxic or mobile transformation products have been identified during recent monitoring that were not already present at the time of the ROD, and therefore did not have cleanup standards specified in the Final SCR.

VI. Five-Year Review Process

Document Review

This five-year review consisted of a review of relevant documents including AMD's Five-Year status report (submitted to the Water Board on June 19, 2001), annual groundwater monitoring reports, and periodic ISB pilot test reports. There have been no changes in the cleanup standards contained in the Final SCR.

Data Review

Groundwater monitoring data collected from 1991 to 2004 were reviewed to evaluate progress in remediating the groundwater pollutant plume. GWET is successful in controlling migration of the plume, in removing VOC mass from saturated soil, and reducing concentrations of VOCs in groundwater. On the basis of decreasing concentrations in the B2-zone aquifer, and an absence of detectable VOC concentrations in the B3-zone, there is no evidence that groundwater contamination has migrated vertically since groundwater extraction began.

Site Inspection

A site inspection was conducted on February 11, 2004 by RWQCB staff. The site has been vacant since 1992. The institutional controls that are in place include prohibitions on the use of groundwater until cleanup levels are achieved. No activities were observed that would have violated the institutional controls. VOC contamination is largely

confined to groundwater; however, vapor intrusion from the groundwater plume into the overlying buildings has not been assessed.

VII. Technical Assessment

Question A: Is the remedy functioning as intended by the decision documents?

The current groundwater monitoring program is sufficient to track the plume and detect any migration beyond the current plume boundaries, as well as track the effectiveness of remedial actions. The remedy selected in the Final Remedial Action Plan (FRAP) (i.e., GWET and institutional controls) was implemented as planned and has achieved some success by removing VOC mass from soil and groundwater, maintaining plume control, and reducing VOC concentrations in groundwater. Contamination remains confined to the shallow groundwater bearing zones. VOC concentrations are declining but remain above cleanup levels. Mass removal efficiency is declining over time and it is not clear if GWET can achieve site cleanup goals on a reasonable time frame.

In October 2002, because of declining effectiveness of the selected remedy, AMD requested and received RWQCB approval to test an in situ remedy (ISB). AMD has determined that the ISB pilot test demonstrated that TCE can be successfully biodegraded to ethane at the site, and that ISB has the potential to accelerate site cleanup. In September 2004 AMD proposed implementing ISB as a full-scale remedy for the 901 Thompson Place property.

The institutional controls in place include prohibitions on the use of groundwater until cleanup levels are achieved. No activities were observed that would have violated the institutional controls.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

In an effort to determine whether the remedy at the AMD 901/902 Thompson Place site remains protective of human health and the environment, this section discusses changes in site conditions, changes in exposure pathways, changes in toxicity values, changes in remedial action objectives, and changes in ARARs since selection of the Site remedy.

Changes in Site Conditions

The AMD 901/902 Thompson Place site has been vacant since 1992. The use of the downgradient area under which the commingled groundwater plume has migrated remains commercial, light industrial, office space, and residential. Three schools are located above the off-site groundwater plume.

Site conditions have not changed appreciably in the past decade. The protectiveness of the remedy has not been affected by any changes since the last review period.

Changes in Exposure Pathways

A baseline human health risk assessment for the AMD site was conducted in 1990. This risk assessment was incorporated into the RI/FS Report and FRAP, and was used in evaluating and selecting remedial options for the site. The risk assessment focused on the potential for future exposure to contamination if the groundwater and its contaminant sources were left untreated, and if that water was used for domestic purposes (e.g., drinking, showering, washing). Exposure to contamination through these pathways contributes the greatest risk to human health where those pathways are complete. However, groundwater at the site is not currently used for domestic purposes; thus, those exposure scenarios were considered unlikely. Additionally, because the contamination at the site is primarily in the groundwater, the 1990 risk assessment concluded that potential exposure to site contaminants through the inhalation pathway presented negligible risks.

Since 1990, however, the understanding of the fate and transport of chemicals in the subsurface has evolved. We now understand that, under certain conditions, VOCs in the soil and/or groundwater emit vapors that can migrate upward through subsurface soils and enter overlying buildings through cracks in floors or through piping conduits. In September 2002, USEPA's Office of Solid Waste and Emergency Response (OSWER) released an external review draft "Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils" (2002) that focuses specifically on this pathway. Given the relatively shallow water table at the site (approximately 10 feet bgs), coupled with the moderate TCE concentrations that have been measured in groundwater beneath the building in recent years (generally around 1,000 ug/L), USEPA identified the AMD 901/902 Thompson Place site as one that might require evaluation of the potential for groundwater contamination to impact indoor air. Indoor air at the 901/902 Thompson Place site has not been sampled for VOCs.

Changes in Toxicity Values

Since the 1990 risk assessment, there have been a number of changes to the toxicity values for certain contaminants of concern at the Site. Revisions to the toxicity value for 1,1-DCE and VC indicate a lower risk from exposure to these chemicals than previously considered. On the other hand, recent studies of the toxicity values for PCE and TCE may indicate higher risks from exposure than previously considered.

The greatest uncertainty with toxicological changes for site contaminants is associated with TCE. In August 2001, USEPA's Office of Research and Development (ORD) released "Trichloroethylene Health Risk Assessment: Synthesis and Characterization" (TCE Health Risk Assessment) for external peer review. The draft TCE Health Risk Assessment takes into account recent scientific studies of the health risks posed by TCE. According to the draft TCE Health Risk Assessment, for those who have increased susceptibility and/or higher background exposures, TCE could pose a higher risk through inhalation than previously considered. The Draft TCE Health Risk Assessment is available online at: http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=23249.

The Science Advisory Board, a team of outside experts convened by USEPA, reviewed the draft TCE Health Risk Assessment in 2002. The Science Advisory Board's review of

the draft TCE Health Risk Assessment is available at:
http://www.epa.gov/sab/pdf/ehc03002.pdf.

USEPA's ORD and OSWER have requested additional external peer review of the draft TCE Health Risk Assessment by the National Academy of Sciences. Consequently, review of the toxicity value for TCE may continue for a number of years. In the interim, because of the uncertainties associated with the draft TCE Health Risk Assessment, USEPA Region 9 is considering both the draft TCE Health Risk Assessment toxicity values, as well as the California TCE toxicity value (similar to USEPA's previously listed TCE toxicity value from 1987), in evaluating potential health risks from exposure, and in making protectiveness determinations. These values will be used to evaluate human health risk from vapor intrusion once indoor air has been sampled.

USEPA evaluates potential health risks by considering a number of important factors: the toxicity of the chemical, the amount of the chemical, the exposure pathway, and the duration to which an individual may be exposed to the chemical. USEPA uses a toxicity assessment to identify what types of health effects each chemical can cause, and how much exposure is harmful (such as the TCE Health Risk Assessment). The results of the risk characterization are probabilities, not certainties, and are typically based on maximum exposures to the most sensitive members of a community. Risk characterizations are never predictions of health outcomes for any individual in a community.

Changes in Remedial Action Objectives
The Final Remedial Action Plan (FRAP) for the AMD 901/902 Thompson Place site approved by the RWQCB and USEPA in 1991 focused on reducing levels of contaminants in groundwater (and contaminant sources to groundwater) so that the groundwater could ultimately be used for domestic purposes. At that time, plans to mitigate the subsurface vapor intrusion pathway were not considered.

Changes in ARARs
The Applicable or Relevant and Appropriate Requirements (ARARs) and cleanup levels for soil contamination at the AMD site have been met in accordance with the Final Site Cleanup Order. There have been no changes in ARARs, affecting operations of the remedy or the protectiveness of the remedy.

The RWQCB has developed risk-based Environmental Screening Levels (ESL) for a variety of exposure routes including vapor intrusion into buildings from underlying groundwater contamination. The current levels of TCE and cis-1,2-DCE in groundwater beneath the building are below the RWQCB's residential screening levels for potential indoor air risk. TCE concentrations may still exceed levels of concern if the new draft USEPA guidance on TCE toxicity is used in the risk assessment.

One of the action-specific ARARs from the ROD cites the NPDES discharge standards in accordance with the RWQCB Water Quality Control Plan, San Francisco Bay Region (Region 2) (RWQCB, 1995). The Basin Plan references standards that were adopted from USEPA's Ambient Water Quality Criteria, as adopted by the RWQCB in 1986. In

2000, USEPA promulgated the California Toxics Rule, which updates and adds standards for discharges to surface waters. The California Toxics Rule standards for VOCs are not lower than those in the NPDES permits for the groundwater treatment systems; therefore, these new standards do not affect the NPDES discharge standards for the treated effluent, and they do not affect the protectiveness of the remedy.

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

New draft USEPA guidance on the toxicity of TCE and new concerns regarding intrusion of volatile organic vapors, as discussed above, requires a re-evaluation of the protectiveness of the remedy at the AMD 901/902 Thompson Place site. The vapor intrusion pathway has not been evaluated at the site.

The presence of TCE in indoor air at the adjacent TRW and Philips sites suggests indoor may also be an issue at this site. Also, vapor intrusion sampling has been performed during 2003 and 2004 in the Offsite Operable Unit downgradient of the AMD, TRW, and Philips sites. To assess the vapor intrusion pathway over the commingled plume, Philips sampled soil gas at two private schools (Rainbow Montessori and King's Academy) that overlie the plume between the Philips site and Duane Avenue. Soil gas was also sampled at a multi-unit residential complex on the north side of Duane Avenue. Soil-gas concentrations at the residential area were well below the RWQCB ESLs and no residential indoor air sampling was performed. Some of the soil-gas samples collected from the school properties contained TCE at concentrations that exceeded the RWQCB ESLs, however, and indoor air sampling was performed at both schools. Indoor air samples from the schools confirmed the presence of very low levels of TCE (below the RWQCB ESL for residential indoor air of 1.2 micrograms per cubic meter (ug/m^3)) in most of the buildings sampled, suggesting (although not confirming) a vapor intrusion source. One building at Rainbow Montessori was found to contain TCE at levels slightly above the RWQCB ESL of 1.2 ug/m^3. Further investigation determined that this building was not properly ventilated.

The evaluation of the vapor intrusion pathway and long-term human health risk assessment for the Offsite Operable Unit is not complete, but the available data indicate the absence of any short-term health risk from vapor-phase TCE. Proper ventilation may be capable of reducing long-term human health risks to acceptable levels.

Technical Assessment Summary

According to the data reviewed and the site inspection, the remedy is functioning as intended by the Record of Decision. There have no been changes in the physical condition or land use of the site that would reduce the protectiveness of the remedy. Reductions in groundwater concentrations achieved through site remediation have increased the protectiveness of the remedy in reducing exposure to groundwater contamination. The vapor intrusion pathway has not been evaluated at the site.

VIII. Issues

Three issues identified during the review are 1) mass removal efficiency of the GWET system has declined over time, and may not be capable of achieving groundwater cleanup goals on a reasonable schedule; in situ bioremediation may have greater potential towards achieving site cleanup goals than continuing GWET; 2) possible offsite migration of VOCs from this site may inhibit long-term remedial success at downgradient sites; 3) the vapor intrusion threat has not been assessed at this site.

IX. Recommendations and Follow-up Actions

The discharger has proposed implementing a full-scale ISB remedy at the site, based on success of a recently completed pilot test. Any remedy implemented at the site must ensure that contaminated groundwater does not migrate to downgradient properties. The ROD will need to be amended if the remedy is permanently changed from groundwater extraction to ISB. To assess the potential for vapor intrusion, indoor air needs to be sampled and the potential human health risk associated with vapor intrusion into indoor air evaluated.

X. Protectiveness Statement

Remedial actions conducted at the site are achieving success. In situ bioremediation appears to have the potential to accelerate site cleanup. The remedy is currently protective of human health and the environment in terms of limiting ingestion of contaminated water through the use of institutional controls prohibiting the use of shallow groundwater.

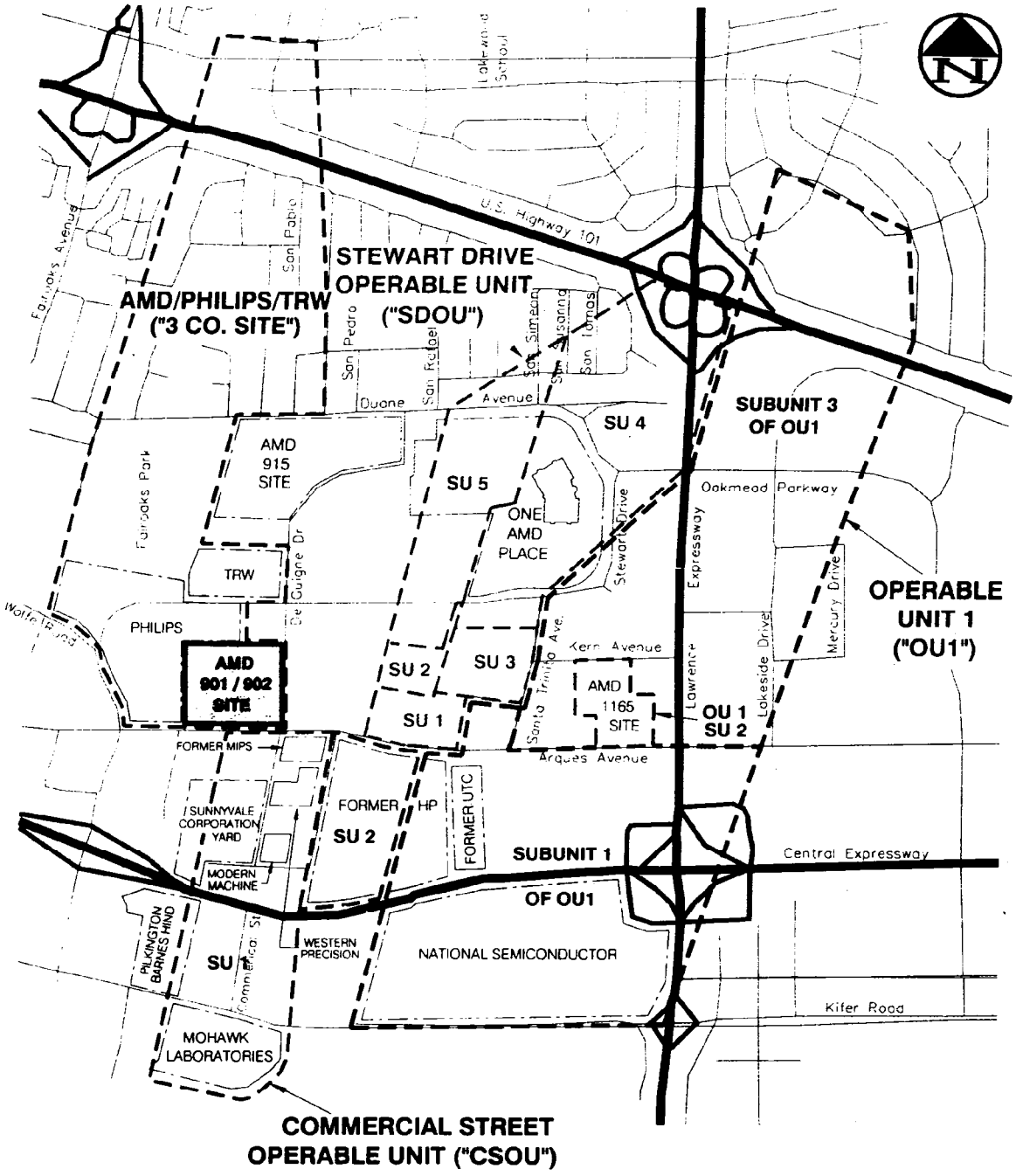
The existing soil and groundwater remedy does not address risks from long-term exposure through the vapor intrusion pathway. Since the issuance of the ROD, new information has been developed concerning the toxicity of TCE and potential vapor intrusion into buildings overlying shallow groundwater contamination. This information, and other recent changes in the methodology of assessing risk from VOCs, requires a re-evaluation of the protectiveness of the remedy in terms of its ability to limit exposure to VOC vapors in indoor air. Indoor air has not been sampled at the AMD 901/902 Thompson Place site. While the available data suggest human health risks should be minimal, RWQCB and USEPA are deferring making a protectiveness statement until an analysis of the risks at this site from the vapor intrusion pathway has been completed.

XI. Next Review

The next five-year review for the AMD 901/902 Thompson Place Superfund site is required by September 30, 2009. In order to re-synchronize the five-year reporting schedule between RWQCB and USEPA, AMD should submit its next Five-Year Summary Report to RWQCB by March 30, 2009 rather than September 30, 2006.

Issues and Recommendations

Issue	*Recommendation and Follow-up Action*	*Responsible Party*	*Oversight Agency*	*Date*	*Affects Protectiveness (Yes/No)*
Mass removal efficiency of the groundwater extraction and treatment remedy is declining over time, and may not be capable of achieving groundwater cleanup goals on a reasonable schedule	AMD has proposed implementing *in situ* bioremediation as the final remedy for the site. The ROD will need to be amended if there is a permanent change in remedy.	AMD	RWQCB	2004	Yes
Possible offsite migration of VOCs from this site may inhibit long-term remedial success at downgradient TRW site	AMD must evaluate and prevent off-site migration of VOCs onto adjacent sites	AMD	RWQCB	2004 - 2005	No
The vapor intrusion pathway has not been assessed at this site	AMD should assess vapor intrusion at the site through soil gas and indoor air sampling	AMD	RWQCB	2005	Yes



LEGEND

OPERABLE UNIT BOUNDARIES

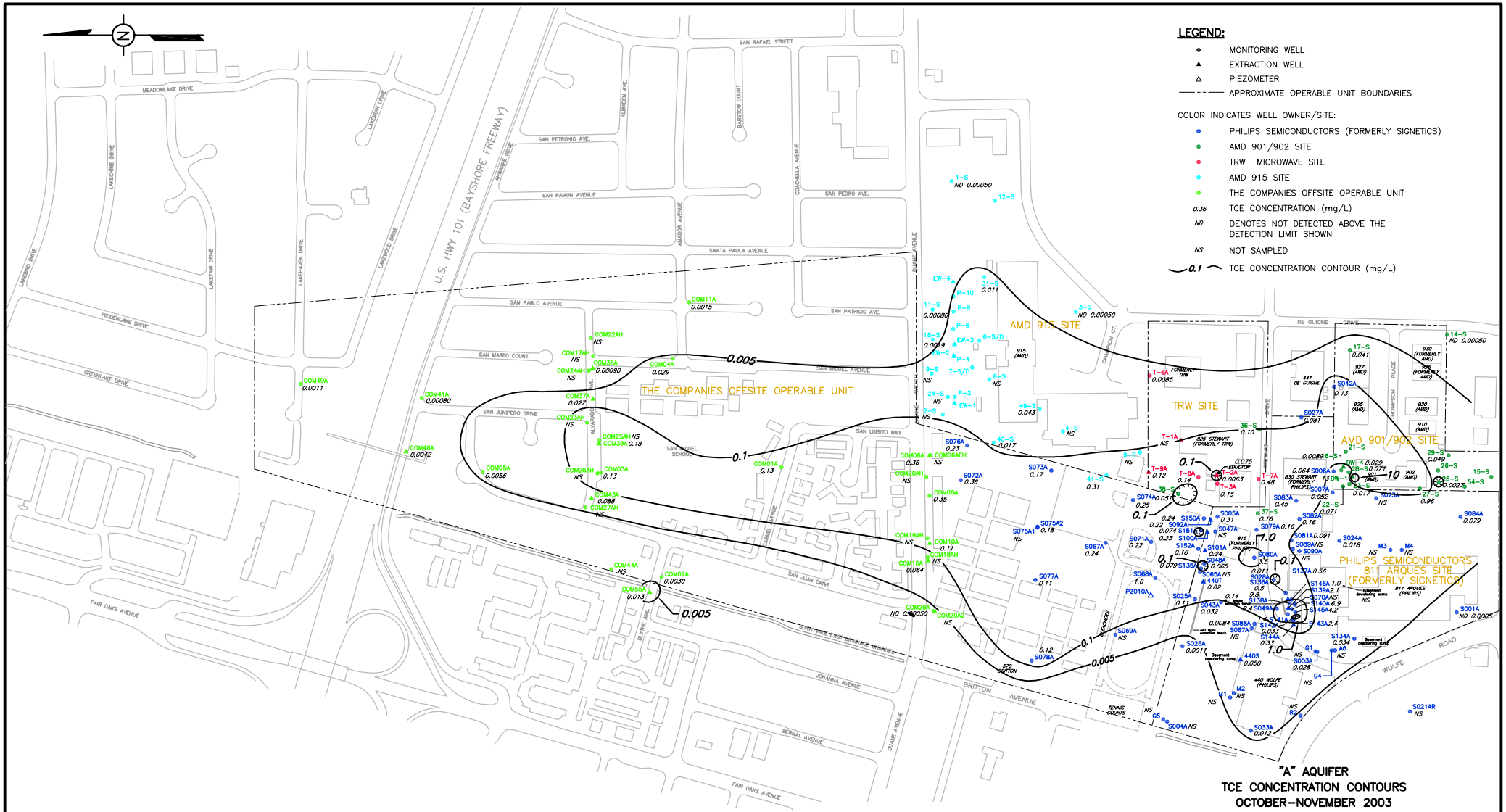
PROPERTY LINES

0 1500' 3000'

All locations are approximate.
Source: Advanced Micro Devices.

EASTERN SUNNYVALE STUDY AREA

Advanced Micro Devices, Inc.
901/902 Thompson Place Facility
Sunnyvale, California



REFERENCES:

1. BASE MAP FROM KIER AND WRIGHT, NOVEMBER 1997.
2. EMCON DRAWING NO. EXGWE-A, FEBRUARY 1998.

No.	DATE	ISSUE / REVISION	DWN. BY	CK'D BY	AP'D BY
1	23 JAN 04	ISSUED FOR REPORT	VZC	GRG	JWH

Locus TECHNOLOGIES

SCALE 200 0 200 400 FEET

DRAWING NO. 99-014-E224

FIGURE 8

K:\99-014\E224.DWG 19 JAN 04